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PATENT ABSTRACTS OF JAPAN

(11)Publication number : 09-318594
(43)Date of publication of application : 12.12.1997

(51)Int.Cl. G01N 27/41
G01N 27/26
G01N 27/419

(21)Application number : 09-045050
(22)Date of filing : 28.02.1997

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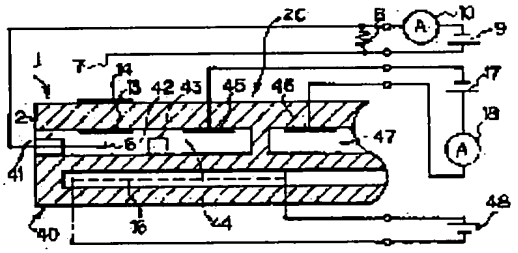
(30)Priority
Priority number : 08 67755 Priority date : 25.03.1996 Priority country : JP

(54) GAS SENSOR AND METHOD FOR MEASURING QUANTITY OF SPECIFIC COMPONENT IN GAS TO BE MEASURED

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a gas sensor in which the sensitivity of individual sensor can be corrected with small number of terminals while enhancing the reliability without increasing the cost, and a method for measuring the quantity of specific component in a gas to be measured.
SOLUTION: A measuring electrode 45 and a reference electrode 46 are arranged on the side where a gas to be measured is introduced while being pumped through a main pump means 1. The electrodes 45, 46 and a solid electrolyte barrier wall 2 constitute a measuring pump means 20 having output terminals connected with a power supply 17 and a current detection means 18. A circuit comprising a power supply 9 and a current detection means 10 is formed between the output terminals 6, 7 of the main pump means 1 and a fixed resistor 8 having resistance corresponding to the sensitivity of the main pump means 1 is connected in parallel between the output terminals 6, 7.



LEGAL STATUS

[Date of request for examination] 30.07.2002

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]
[Date of registration]
[Number of appeal against examiner's decision of rejection]
[Date of requesting appeal against examiner's decision of rejection]
[Date of extinction of right]

(19)日本国特許庁（ＪＰ）　(12)公開特許公報（Ａ）　(11)特許出願公開番号

特開平9－318594

(43)公開日　平成９年(1997)12月12日

(51)Int.Cl.[6]	識別記号	庁内整理番号	ＦＩ		技術表示箇所
Ｇ０１Ｎ　27/41			Ｇ０１Ｎ　27/46	３２５Ｎ	
27/26	３８１		27/26	３８１Ｂ	
27/419			27/46	３２７Ｎ	

審査請求　未請求　請求項の数12　ＯＬ　（全９頁）

(21)出願番号　特願平9－45050

(22)出願日　平成９年(1997)２月28日

(31)優先権主張番号　特願平8－67755

(32)優先日　平８(1996)３月25日

(33)優先権主張国　日本（ＪＰ）

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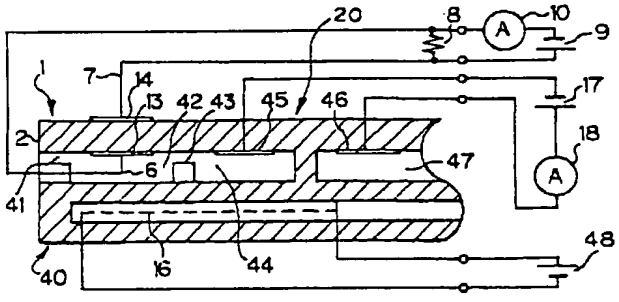
(54)【発明の名称】　ガスセンサおよび被測定ガス中の特定成分量の測定方法

(57)【要約】　（修正有）

【課題】　少ない端子数で個々のセンサの感度補正が可能であり、信頼性が向上し、コストの上昇を招来しないガスセンサと、被測定ガス中の特定成分量の測定方法を提供する。

【解決手段】　主ポンプ手段１にてポンピング処理された被測定ガスが導入される側には測定電極４５と基準電極４６が設けられ、この電極４５，４６と固体電解質隔壁２とによって測定用ポンプ手段２０が構成され、かつ測定用ポンプ手段２０の出力端子間には、電源１７及び電流検出手段１８を有している。主ポンプ手段１の出力端子６，７間には電源９及び電流検出手段１０を有する回路を形成しているとともに、出力端子６，７間に、主ポンプ手段１の感度に対応した抵抗値を持つ固定抵抗８を並列に接続している。



1

【特許請求の範囲】

【請求項1】　外部空間に接する固体電解質隔壁と、該固体電解質隔壁の内面及び外面に形成された内側ポンプ電極及び外側ポンプ電極からなる電気化学的ポンプセルを有し、且つ、前記外部空間から導入された被測定ガスに含まれる酸素を、前記内側ポンプ電極と前記外側ポンプ電極間に印加される制御電圧に基づいてポンピング処理する主ポンプ手段を備えてなる、被測定ガス中の特定成分量を検出するガスセンサであって、

前記電気化学的ポンプセルに並列に、前記電気化学的ポンプセルの特性値に対応する所定の電気特性値を有するＲＬＣ要素を接続したことを特徴とするガスセンサ。

【請求項2】　外部空間に接する固体電解質隔壁と、該固体電解質隔壁の内面及び外面に形成された内側ポンプ電極及び外側ポンプ電極からなる電気化学的ポンプセルを有し、且つ、前記外部空間から導入された被測定ガスに含まれる酸素を、前記内側ポンプ電極と前記外側ポンプ電極間に印加される制御電圧に基づいてポンピング処理する主ポンプ手段と、

一方が前記主ポンプ手段にてポンピング処理された被測定ガスが導入される側に設けられた一対の検出電極を有し、前記主ポンプ手段にてポンピング処理された後の被測定ガスに含まれる目的成分の分解あるいは還元により発生する酸素の量に応じた電気信号を発生する電気信号変換手段と、を備えた被測定ガス中の特定成分量を検出するガスセンサであって、

前記電気化学的ポンプセルあるいは前記電気信号変換手段の出力端子に並列に、前記ガスセンサの電気信号特性に対応した所定の電気特性値を有するＲＬＣ要素を接続したことを特徴とするガスセンサ。

【請求項3】　前記電気信号変換手段が、

前記主ポンプ手段にてポンピング処理された後の被測定ガスに含まれる目的成分の分解あるいは還元により発生する酸素を、前記一対の検出電極間に印加される測定用電圧に基づいてポンピング処理する測定用ポンプ手段と、

前記測定用ポンプ手段に生じるポンプ電流を検出する電流検出手段とを具備し、

前記電流検出手段にて検出されたポンプ電流に基づいて、被測定ガス中の特定成分量を測定することを特徴とする請求項2記載のガスセンサ。

【請求項4】　前記電気信号変換手段が、

前記主ポンプ手段にてポンピング処理された後の被測定ガスに含まれる目的成分の分解あるいは還元により発生する酸素の量と、対照ガス側に設けられた検出電極側の対照ガスに含まれる酸素の量との差に応じた起電力を発生する濃度検出手段と、

前記濃度検出手段に生じる起電力を検出する電圧検出手段とを具備し、

前記電圧検出手段にて検出された起電力に基づいて、被

2

測定ガス中の特定成分量を測定することを特徴とする請求項2記載のガスセンサ。

【請求項5】　前記ＲＬＣ要素が、抵抗である請求項1又は2記載のガスセンサ。

【請求項6】　前記ＲＬＣ要素が、コンデンサ、コンデンサと抵抗の直列回路、及びコンデンサとインダクタの直列回路よりなる群から選ばれた少なくとも一つである請求項1又は2記載のガスセンサ。

【請求項7】　前記ＲＬＣ要素が、特定の周波数において極大あるいは極小値を持つ請求項1又は2記載のガスセンサ。

【請求項8】　外部空間に接する固体電解質隔壁と、該固体電解質隔壁の内面及び外面に形成された内側ポンプ電極及び外側ポンプ電極からなる電気化学的ポンプセルを有するセンサの主ポンプ手段を用いて、前記外部空間から導入された被測定ガスに含まれる酸素を、前記内側ポンプ電極と前記外側ポンプ電極間に印加される制御電圧に基づいてポンピング処理して、被測定ガス中の酸素分圧を所定の値に制御することにより、被測定ガス中の特定成分量を測定する方法において、

前記電気化学的ポンプセルに並列に、前記電気化学的ポンプセルの特性値に対応する所定の電気特性値を有するＲＬＣ要素を接続するとともに、その両端をセンサ出力端子に接続し、

常温において、固体電解質のイオン伝導性を排除した状態における前記ＲＬＣ要素の電気特性値を測定することにより、前記電気化学的ポンプセルの高温での出力を補正する設定を行い、

この設定に基づいて前記電気化学的ポンプセルの出力を補正することを特徴とする被測定ガス中の特定成分量の測定方法。

【請求項9】　外部空間に接する固体電解質隔壁と、該固体電解質隔壁の内面及び外面に形成された内側ポンプ電極及び外側ポンプ電極からなる電気化学的ポンプセルを有するセンサの主ポンプ手段を用いて、前記外部空間から導入された被測定ガスに含まれる酸素を、前記内側ポンプ電極と前記外側ポンプ電極間に印加される制御電圧に基づいてポンピング処理することにより、被測定ガス中の酸素分圧を所定の値に制御し、

一方が前記主ポンプ手段にてポンピング処理された被測定ガスが導入される側に設けられた一対の検出電極を有する電気信号変換手段を用いて、前記主ポンプ手段にてポンピング処理された後の被測定ガスに含まれる目的成分を、分解あるいは還元により発生する酸素の量に応じた電気信号に変換し、

前記電気信号変換手段からの電気信号に基づいて被測定ガス中の特定成分量を測定する、被測定ガス中の特定成分量の測定方法であって、

前記電気化学的ポンプセルあるいは前記電気信号変換手段の出力端子に並列に、前記電気信号の特性に対応した

3

所定の電気特性値を有するＲＬＣ要素を接続するとともに、その両端をセンサ出力端子に接続し、
常温において、固体電解質のイオン伝導性を排除した状態における前記ＲＬＣ要素の電気特性値を測定することにより、前記電気信号変換手段の高温での出力を補正する設定を行い、
この設定に基づいて前記電気信号変換手段の出力を補正することを特徴とする被測定ガス中の特定成分量の測定方法。

【請求項１０】　前記ＲＬＣ要素が、抵抗である請求項８又は９記載の測定方法。

【請求項１１】　前記ＲＬＣ要素が、コンデンサ、コンデンサと抵抗の直列回路、及びコンデンサとインダクタの直列回路よりなる群から選ばれた少なくとも一つである請求項８又は９記載の測定方法。

【請求項１２】　前記ＲＬＣ要素が、特定の周波数において極大あるいは極小値を持つ請求項８又は９記載の測定方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】　本発明は、被測定ガス中の特定成分量を検出するガスセンサおよび被測定ガス中の特定成分量の測定方法に係わり、特にセンサ間の出力特性のばらつきを、正確に且つ簡単に補正することができるガスセンサおよび測定方法に関するものである。

【０００２】

【従来の技術】　従来、ジルコニア磁器等の固体電解質からなる隔壁に一対の電極を設けた電気化学的ポンプセルを用い、この両電極間に通電した場合の拡散限界電流を測定することにより、被測定ガス中の特定成分、例えば酸素ガス量を測定する方法が知られている。この際、拡散限界電流は、センサ素子の構造、特に電極の微構造やガス拡散抵抗層の気孔率等のバラツキにより変化する為、正確な測定を行う為には、それぞれのセンサ素子の感度に応じた補正をする必要があった。この補正をするに当たっては、分析計などに使用するセンサと異なり、自動車部品としてのセンサにおいては、インターフェース側でセンサ特性の個体バラツキを調整することはできない。そこで、自動車搭載用センサには、何らかの個体バラツキの補正をする手段が必要であった。

【０００３】　このような個体バラツキを補正する方法としては、従来、
１）図８に示すように、拡散限界電流を２つの抵抗３２，３３を用いて分流し、拡散限界電流を所定の値に調整する方法、
２）センサの特性を測定した後にその特性をランク分けし、図７に示すように、各ランクに対応した値の固定抵抗１２をコネクタケースに内蔵する方法、などがあった。

【０００４】　図８に示す方法は、固体電解質隔壁２と、その内面及び外面に設けられた一対の電極３，４と、該電極３上に設けられたガス拡散抵抗層５とからなる電気化学的ポンプセル６０の出力端子６，７間に、電源９と電流検出手段１０を有する回路を形成したもので、電気化学的ポンプセル６０に流れる拡散限界電流を抵抗３２と３３で分流して、電流検出手段１０に被測定ガス中の特定成分の濃度に比例した電流を流す方法である。また、図７の方法では、固体電解質隔壁２の内面及び外面に設けられた一対の電極３，４と、該電極３上に設けられたガス拡散抵抗層５とからなる電気化学的ポンプセル６０の出力端子６，７間に、電源９と電流検出手段１０を有する回路を形成してなるセンサに対して、その特性を測定した後にその特性をランク分けする。次いで、図７に示すように、各ランクに対応した値の固定抵抗１２を内蔵したコネクタケースを電気化学的ポンプセル６０に組み合わせ、該固定抵抗１２に直列に接続した別の電流検出手段１５にて電流を検出する方法である。

【０００５】

【発明が解決しようとする課題】　しかしながら、上記した分流抵抗を設けたセンサ、あるいは各ランクに対応した値の固定抵抗を取り付けたセンサにおいては、コネクタの端子数が多くなり、信頼性の低下とコストの上昇をまねくという欠点があった。本発明は、これら従来の補正方法の課題を解決できる補正方法を提供することを目的とするものである。

【０００６】

【課題を解決するための手段】　上記の目的を達成するため、本発明によれば、外部空間に接する固体電解質隔壁と、該固体電解質隔壁の内面及び外面に形成された内側ポンプ電極及び外側ポンプ電極からなる電気化学的ポンプセルを有し、且つ、前記外部空間から導入された被測定ガスに含まれる酸素を、前記内側ポンプ電極と前記外側ポンプ電極間に印加される制御電圧に基づいてポンピング処理する主ポンプ手段を備えてなる、被測定ガス中の特定成分量を検出するガスセンサであって、前記電気化学的ポンプセルに並列に、前記電気化学的ポンプセルの特性値に対応する所定の電気特性値を有するＲＬＣ要素を接続したことを特徴とするガスセンサが提供される。

【０００７】　また、本発明によれば、外部空間に接する固体電解質隔壁と、該固体電解質隔壁の内面及び外面に形成された内側ポンプ電極及び外側ポンプ電極からなる電気化学的ポンプセルを有し、且つ、前記外部空間から導入された被測定ガスに含まれる酸素を、前記内側ポンプ電極と前記外側ポンプ電極間に印加される制御電圧に基づいてポンピング処理する主ポンプ手段と、一方が前記主ポンプ手段にてポンピング処理された被測定ガスが導入される側に設けられた一対の検出電極を有し、前記主ポンプ手段にてポンピング処理された後の被測定ガスに含まれる目的成分の分解あるいは還元により発生す

5

る酸素の量に応じた電気信号を発生する電気信号変換手段と、を備えた被測定ガス中の特定成分量を検出するガスセンサであって、前記電気化学的ポンプセルあるいは前記電気信号変換手段の出力端子に並列に、前記ガスセンサの電気信号特性に対応した所定の電気特性値を有するＲＬＣ要素を接続したことを特徴とするガスセンサが提供される。本発明においては、電気信号変換手段は、主ポンプ手段にてポンピング処理された後の被測定ガスに含まれる目的成分の分解あるいは還元により発生する酸素を、一対の検出電極間に印加される測定用電圧に基づいてポンピング処理する測定用ポンプ手段と、この測定用ポンプ手段に生じるポンプ電流を検出する電流検出手段とを具備したものが好ましく、この場合には、電流検出手段にて検出されたポンプ電流に基づいて被測定ガス中の特定成分量を測定する。また、この電気信号変換手段は、主ポンプ手段にてポンピング処理された後の被測定ガスに含まれる目的成分の分解あるいは還元により発生する酸素の量と、対照ガス側に設けられた検出電極側の対照ガスに含まれる酸素の量との差に応じた起電力を発生する濃度検出手段と、この濃度検出手段に生じる起電力を検出する電圧検出手段とを具備したものであってもよく、この場合には、電圧検出手段にて検出された起電力に基づいて被測定ガス中の特定成分量を測定する。

【０００８】　更に本発明によれば、外部空間に接する固体電解質隔壁と、該固体電解質隔壁の内面及び外面に形成された内側ポンプ電極及び外側ポンプ電極からなる電気化学的ポンプセルを有するセンサの主ポンプ手段を用いて、前記外部空間から導入された被測定ガスに含まれる酸素を、前記内側ポンプ電極と前記外側ポンプ電極間に印加される制御電圧に基づいてポンピング処理して、被測定ガス中の酸素分圧を所定の値に制御することにより、被測定ガス中の特定成分量を測定する方法において、前記電気化学的ポンプセルに並列に、前記電気化学的ポンプセルの特性値に対応する所定の電気特性値を有するＲＬＣ要素を接続するとともに、その両端をセンサ出力端子に接続し、常温において、固体電解質のイオン伝導性を排除した状態における前記ＲＬＣ要素の電気特性値を測定することにより、前記電気化学的ポンプセルの高温での出力を補正する設定を行い、この設定に基づいて前記電気化学的ポンプセルの出力を補正することを特徴とする被測定ガス中の特定成分量の測定方法が提供される。

【０００９】　さらにまた、本発明によれば、外部空間に接する固体電解質隔壁と、該固体電解質隔壁の内面及び外面に形成された内側ポンプ電極及び外側ポンプ電極からなる電気化学的ポンプセルを有するセンサの主ポンプ手段を用いて、前記外部空間から導入された被測定ガスに含まれる酸素を、前記内側ポンプ電極と前記外側ポンプ電極間に印加される制御電圧に基づいてポンピング

6

処理することにより、被測定ガス中の酸素分圧を所定の値に制御し、一方が前記主ポンプ手段にてポンピング処理された被測定ガスが導入される側に設けられた一対の検出電極を有する電気信号変換手段を用いて、前記主ポンプ手段にてポンピング処理された後の被測定ガスに含まれる目的成分を、分解あるいは還元により発生する酸素の量に応じた電気信号に変換し、前記電気信号変換手段からの電気信号に基づいて被測定ガス中の特定成分量を測定する、被測定ガス中の特定成分量の測定方法であって、前記電気化学的ポンプセルあるいは前記電気信号変換手段の出力端子に並列に、前記電気信号の特性に対応した所定の電気特性値を有するＲＬＣ要素を接続するとともに、その両端をセンサ出力端子に接続し、常温において、固体電解質のイオン伝導性を排除した状態における前記ＲＬＣ要素の電気特性値を測定することにより、前記電気信号変換手段の高温での出力を補正する設定を行い、この設定に基づいて前記電気信号変換手段の出力を補正することを特徴とする被測定ガス中の特定成分量の測定方法が提供される。

【００１０】　以上のとおり、本発明は、上記した従来方法２）の改良に関するもので、本発明では、自動車に搭載されているインターフェースは、各ランクに応じた補正値を記憶しており、センサを作動させる前に、センサ側のラベルを読み取り、所定の補正値を選択して、センサ出力を補正することになる。なお、本発明においては、ＲＬＣ要素が抵抗（Ｒ）であることが好ましく、また、ＲＬＣ要素がコンデンサ（Ｃ）、コンデンサ（Ｃ）と抵抗（Ｒ）の直列回路、またはコンデンサ（Ｃ）とインダクタ（Ｌ）の直列回路であることが好ましい。さらに、ＲＬＣ要素として、これらの抵抗、コンデンサ及びインダクタの組み合わせのほか、特定の周波数においてインピーダンス等が極大値あるいは極小値を有する振動子、フィルターなどを用いることもできる。

【００１１】

【発明の実施の形態】　図１は本発明の基本的構成の一例を示す回路図であり、ジルコニア磁器等の常温においてイオン伝導性を実質的に示さず、高温においてイオン伝導性を示す固体電解質隔壁２と、その内面及び外面に設けられた一対の電極３，４と、該電極３上に設けられたガス拡散抵抗層５とからなる電気化学的ポンプセル１の出力端子６，７に、該セルの感度に対応した抵抗値を持つ固定抵抗８を並列に接続している。

【００１２】　上記のようにセンサ回路を構成した場合、電気化学的ポンプセル１の出力端子６，７に、電源９から所定の電圧（制御電圧）を印加すると、常温では前記セル１のインピーダンスは非常に高いので、セル１には殆ど電流は流れず、主として固定抵抗８のみに電流が流れる。従って、この電流を電流検出手段１０で測定すれば、固定抵抗８の抵抗値を読み取ることができる。この抵抗値はそれぞれのセルの感度に対応した値に設定

されているから、その情報をセルに流れる電流検出手段１０に記憶せしめ、セルが高温で作動した場合の電流値を次式に基づいて補正することができる。

【００１３】$I_0 = K_0 \ (I_0 - V/R_0)$

但し、I_0はセルの感度補正後の拡散限界電流値、K_0は各セルの感度に対応した補正係数、I_0は電流検出手段１０に流れる電流値、R_0は固定抵抗８の抵抗値、Ｖは電源９の電圧である。なお、電流検出手段１０の内部抵抗は無視できる程度に小さいものとする。

【００１４】　ここで、図１においては抵抗であるＲＬＣ要素の電気特性値が代表する電気化学的ポンプセルの特性値（後述する図３～図５のごとく、電気信号変換手段を有する場合には、センサの電気信号特性）としては、セル（センサ出力）の感度、オフセット値が挙げられる。セル（センサ出力）の感度としては、

①被測定ガス中の特定成分の濃度に対する、ポンプ電流の増加の割合、

②被測定ガス中の特定成分の濃度に対する、起電力の減少の割合、

③被測定ガス中の特定成分の濃度に対する、抵抗の変化の割合、

などがある。また、セル（センサ出力）のオフセット値としては、

①被測定ガス中の特定成分の濃度が０のときに流れる、ポンプ電流の値、

②被測定ガス中の特定成分の濃度が０のときに発生する、起電力の値、

③被測定ガス中の特定成分の濃度が０のときの、抵抗値、

などがある。

【００１５】　この結果、図１においては、I_0は各セルの感度のバラツキを補正した値となり、被測定ガスの組成と極めて良い相関が得られることとなる。なお、固定抵抗８はセンサ素子上にサーメット抵抗として焼き付けても良く、センサーのコネクタケース内に収容しても良い。

【００１６】　図２は本発明の他の基本構成の一例を示す回路図であり、図１の基本構成と同様に、固体電解質隔壁２と、その内面及び外面に設けられた一対の電極３，４と、該電極３上に設けられたガス拡散抵抗層５とからなる電気化学的ポンプセル１の出力端子６，７間に電源９及び電流検出手段１０を有する回路を形成している。また、ジルコニア磁器等の固体電解質隔壁２の内面及び外面には、さらに一対の電極２３，２４を設け、該電極２３上に設けられたガス拡散層５にて電気化学的ポンプセル２１を構成し、その出力端子２６，２７に、該セル２１に隣接する電気化学的ポンプセル１の感度に対応した抵抗値を持つ固定抵抗２８をコンデンサ２９を介して並列に接続している。

【００１７】　上記のようにセンサ回路を構成した場合

には、セル２１の出力端子２６，２７に、交流電源３０からコンデンサ３１を介して所定の電圧を印加すると、常温ではセル２１のインピーダンスは非常に高いので、セル２１には殆ど電流は流れず、主として固定抵抗２８のみに電流が流れる。従って、この電流を第二の電流検出手段１１で測定すれば、固定抵抗２８の抵抗値を読み取ることができる。この抵抗値は電気化学的ポンプセル１の感度に対応した値に設定されているから、その情報を第二の電流検出手段１１に記憶せしめ、セル２１が高温で作動した場合の電流値を次式に基づいて補正することができる。

【００１８】$I_0 = K_0 \times I_0$

但し、I_0はセルの感度補正後の拡散限界電流値、K_0は各セルの感度に対応した補正係数、I_0は電流検出手段１０に流れる電流値である。

【００１９】　この方法によれば、電気化学的ポンプセル１の電流検出回路に影響を及ぼすこと無く、且つ、電気化学的ポンプセル２１が起電力を測定する方式のセルであっても、その起電力に影響を及ぼすことも無く補正することが可能となる。例えば、図２において、電位差（電圧）検出手段３５では、電極２３，２４間の酸素濃度差に応じた起電力が測定されることになり、この起電力を所定の値に制御するように電気化学的ポンプセル１に印加される電圧が調整される。

【００２０】

【実施例】　以下、本発明の実施例について、図面を参照しつつ更に詳細に説明する。図３はヒーター部を備えたＮＯｘセンサの主要部の断面と電気回路を示す。図３において、ＮＯｘセンサ内には、第一の内部空所４２及び第二の内部空所４４が、センサ素子先端側に第一の内部空所４２が位置するようにして別個に配設されているとともに、それら第一の内部空所４２及び第二の内部空所４４とは独立した形態において、基準ガス存在空所としての基準ガス導入空間４７がセンサ素子の長手方向に延びるように設けられている。また、第一の内部空所４２を外部の被測定ガス存在空間に連通せしめる第一の拡散律速部４１がセンサ素子先端に設けられているとともに、第一の内部空所４２と第二の内部空所４４とは、第二の拡散律速部４３を介して連通している。

【００２１】　固体電解質隔壁２の第一の内部空所４２内に露呈する部分には、内側ポンプ電極１３が設けられ、該内側ポンプ電極１３に対応する固体電解質隔壁２の外面部位には外側ポンプ電極１４が設けられており、それら電極１３，１４と固体電解質隔壁２とによって主ポンプ手段（電気化学的ポンプセル）１が構成されている。そして、主ポンプ手段１の出力端子６，７間に電源９及び電流検出手段１０を有する回路を形成しているとともに、出力端子６，７間に、該主ポンプ手段１の感度に対応した抵抗値を持つ固定抵抗８を並列に接続している。

9

【００２２】　さらに、固体電解質隔壁２の第二の内部空所４４内に露呈する部分には、測定電極４５が設けられているとともに、固体電解質隔壁２の基準ガス導入空間４７内に露呈する部分には、基準電極４６が設けられており、それら測定電極４５と基準電極４６と固体電解質隔壁２とによって測定用ポンプ手段２０が構成されている。そして、測定用ポンプ手段２０の出力端子間には、電源１７及び電流検出手段１８を有する回路が形成されている。なお、ＮＯｘセンサにはヒーター部４０が設けられており、固体電解質にて囲まれた形態でヒーター１６が埋設され、ヒーター用電源４８からの給電によって発熱せしめられるようになっている。

【００２３】　このような構成のＮＯｘセンサにおいては、被測定ガスは第一の拡散律速部４１を通って第一の内部空所４２に入り、ここでジルコニア磁器よりなる固体電解質隔壁２の内外面に対向して設けられた一対のポンプ電極１３，１４に所定の電圧を有する電源９から通電することにより、酸素ガスの拡散限界電流の値が電流検出手段１０によって求められる。また、この内部空所４２で分解されないＮＯは第二の拡散律速部４３を通って第二の内部空所４４に入り、ここで、電源１７により測定電極４５及び基準電極４６の間に印加される電圧によりＮＯが分解され、それに伴って放出される酸素を電流検出手段１８で求めることにより、ＮＯｘも測定される。ここで、抵抗８の値を第一の内部空所４２における酸素ガスに対する感度、あるいは、第二の内部空所４４におけるＮＯｘガスに対する感度に対応する値に設定しておけば、常温において、抵抗８の値を電流検出手段１０で測定し、その値に基づいた補正係数により、主ポンプ手段１に流れるポンプ電流値、あるいは測定用ポンプ手段３に流れる電流値を補正することができる。特に、ＮＯｘ濃度を補正する場合には、主ポンプ手段１はＮＯを分解しないので、抵抗８に流れる電流はＮＯｘ測定とは無関係であるため、ＮＯｘ感度、あるいはオフセットの補正が精度良く行える。

【００２４】　図４は別のＮＯｘセンサの主要部の断面と電気回路を示す。この実施例では、ＮＯｘセンサ内には、第一の内部空所４２のみ設けて第二の内部空所４４は配設されておらず、第二の内部空所４４の代わりに、ガス拡散抵抗層からなる第二の拡散律速部４３を形成し、しかも測定電極４５としてＮＯｘガスを分解する触媒活性を有するものを用いたものである。そして、固体電解質隔壁２の第一の内部空所４２内に露呈する部分には、内側ポンプ電極１３が設けられ、一方、固体電解質隔壁２の基準ガス導入空間４７内に露呈する部分には、基準電極を共用する外側ポンプ電極１４が設けられており、それら電極１３，１４と固体電解質隔壁２とによって主ポンプ手段１が構成されている。そして、主ポンプ手段１の出力端子間には電源９を有する回路を形成している。また、第一の内部空所４２内に露呈する別の部分

10

には、ＮＯｘガスを分解する触媒活性を有する測定電極４５が設けられ、この測定電極４５を覆ってガス拡散抵抗層からなる第二の拡散律速部４３が形成されているとともに、固体電解質隔壁２の基準ガス導入空間４７内に露呈する部分には、外側ポンプ電極と共用する基準電極１４が設けられており、それら測定電極４５と基準電極１４と固体電解質隔壁２とによって測定用ポンプ手段が構成されている。そして、測定用ポンプ手段の出力端子間には、電源１７及び電流検出手段１０を有する回路が形成されているとともに、該電気化学的センサセルの出力端子間に固定抵抗８が並列に接続されている。

【００２５】　このような構成のＮＯｘセンサでは、被測定ガスは第一の拡散律速部４１を通って第一の内部空所４２に入り、ここでジルコニア磁器よりなる固体電解質隔壁２の内外面に対向して設けられた一対の電極１３，１４に所定の電圧を有する電源９から通電することにより、第一の内部空所４２内の酸素をほぼゼロの状態とする。次に、第二の拡散律速部４３を通って触媒活性を持つ測定電極４５に到達したＮＯｘガスはここで分解して酸素を放出する。この酸素を電流検出手段１０で求めることにより、ＮＯｘが測定される。ここで、抵抗８の値をＮＯｘガスに対する感度に対応する値に設定しておけば、常温において、抵抗８の値を電流検出手段１０で測定し、その値に基づいた補正係数により、ＮＯｘ感度を精度良く補正することができる。

【００２６】　図５は拡散限界電流型酸素センサの主要部の断面と電気回路を示す。この実施例においては、固体電解質隔壁２の内部空所５２内に露呈する部分には、内側ポンプ電極１３が設けられ、該内側ポンプ電極１３に対応する固体電解質隔壁２の外面部位には外側ポンプ電極１４が設けられており、それら電極１３，１４と固体電解質隔壁２とによって主ポンプ手段１が構成されている。一方、固体電解質隔壁２の内部空所５２内の他の露呈部分には、測定電極５３が設けられているとともに、固体電解質隔壁２の基準ガス導入空間４７内に露呈する部分には、基準電極５４が設けられており、それら測定電極５３と基準電極５４と固体電解質隔壁２とによって酸素濃淡電池が構成されている。そして、主ポンプ手段１の出力端子間には電源９及び電流検出手段１０を有する回路を形成しているとともに、酸素濃淡電池の出力端子間には、交流電源７０、及び抵抗５６とコンデンサ７１の直列回路を接続し、かつ、該酸素濃淡電池の出力端子間に並列に、抵抗６８とコンデンサ６９の直列回路を接続している。

【００２７】　このような構成の酸素センサでは、被測定ガスは拡散律速部５１を通って内部空所５２に入り、ここでジルコニア磁器よりなる固体電解質隔壁２の内外面に対向して設けられた一対の電極１３，１４に所定の電圧を有する電源９から通電することにより、内部空所５２内の酸素をほぼゼロの状態とする。内部空所５２内

の酸素分圧は電極５３，５４と固体電解質２からなる酸素濃淡電池により、基準ガス導入空間４７内の酸素分圧との比により定まる起電力として電位差検出手段５５により検出され、所定の値に等しくなるように電源９の電圧が制御される。このとき、電流検出手段１０に流れる電流が被測定ガス中の酸素濃度に対応する。ここで、抵抗６８の値を酸素ガスに対する感度に対応する値に設定しておけば、常温において、抵抗６８の値を交流電源７０の電圧を抵抗５６と抵抗６８で分圧した値として電位差（電圧）検出手段５５で測定し、その感度をそれぞれのセンサの感度に合わせることができる。但し、コンデンサ６９，７１のインピーダンスは充分小さいものとする。

【００２８】　図６は主ポンプセル１によってO_2分圧が調整された被測定ガスの微少なO_2分圧の変化を更に調整するための補助ポンプセルを備え、起電力にてＮＯｘ濃度を測定するセンサ素子の主要部の断面と電気回路を示す。この実施例を図３の実施例と比較すると、主ポンプ手段１、ヒーター部４０の構成は基本的に同一で、相違する点は補助ポンプ電極８０を設けたこと、およびＮＯｘ濃度を検出電極８２と基準電極４６からなる濃度検出手段９０に発生する起電力から検出するところにある。

【００２９】　この実施例においては、主ポンプ手段１の出力端子６，７間に電源９を有する回路を形成しているとともに、出力端子６，７間に、該濃度検出手段９０の感度に対応した抵抗値を持つ固定抵抗８を並列に接続している。

【００３０】　固体電解質隔壁２の第二の内部空所４４内に露呈する部分には、検出電極８２が設けられているとともに、固体電解質隔壁２の基準ガス導入空間４７内に露呈する部分には、基準電極４６が設けられており、それら検出電極８２と基準電極４６と固体電解質隔壁２とによって濃度検出手段９０が構成されている。また、第二の内部空所４４内の別の部分に補助ポンプ電極８０を設け、この補助ポンプ電極８０と、基準ガス導入空間４７内に設けられた基準電極４６および固体電解質隔壁２とによって補助ポンプ手段８４が構成されている。そして、該濃度検出手段９０の出力端子間には電位差検出手段８３が設けられ、一方、補助ポンプ手段８４の出力端子間には、電源８５を有する回路を形成しているとともに、出力端子間に、該濃度検出手段９０のオフセット値に対応した抵抗値を持つ固定抵抗８８を並列に接続している。

【００３１】　このような構成のＮＯｘセンサにおいては、被測定ガスは第一の拡散律速部４１を通って第一の内部空所４２に入り、ここで固体電解質隔壁２の内外面に対向して設けられた一対のポンプ電極１３，１４に所定の電圧を電源９から通電することによって起こる酸素ポンピング作用により、酸素分圧はＮＯが分解しない所

定の値に制御される。酸素分圧が所定の値に制御された被測定ガスは、第二の拡散律速部４３を通って第二の内部空所４４に入り、電源８５により補助ポンプ電極８０及び基準電極４６の間に印加される電圧によって、更に低い酸素分圧に調整される。ここで、同じく第二の内部空所４４に配設されたＮＯ分解能力のある検出電極８２上でＮＯは分解され、それに伴って発生する酸素を電位差検出手段８３で求めることにより、ＮＯｘ濃度が測定される。

【００３２】　そこで、抵抗８の値を濃度検出手段９０の感度（ＮＯｘ濃度に対する起電力の減少の割合）、抵抗８８の値を濃度検出手段９０のオフセット値に対応する値にそれぞれ設定しておけば、常温において、抵抗８の値と抵抗８８の値を電流検出手段１０および８１で測定することにより、そのセンサの最適な補正係数をセンサ作動前に設定することができるので、ＮＯｘ濃度をより精度良く測定することができる。なお、上記の説明では、電気化学的ポンプセルが２つある素子に、抵抗を２つ配した例を示したが、抵抗は他のＲＬＣ要素であってもかまわない。また、ポンプセルの数に応じて、ＲＬＣ要素の数は自在に変更することができる。

【００３３】

【発明の効果】　以上説明したように、本発明によれば、少ない端子数で個々のセンサの感度補正が可能であり、しかも、信頼性が向上し、コストの上昇を招来しないものであり、産業上極めて有用である。

【図面の簡単な説明】

【図１】　本発明の基本構成の一例を示すセンサ素子の主要部の断面と回路図である。

【図２】　本発明の基本構成の他の一例を示すセンサ素子の主要部の断面と回路図である。

【図３】　本発明の一実施例を示すセンサ素子の主要部の断面と回路図である。

【図４】　本発明の他の実施例を示すセンサ素子の主要部の断面と回路図である。

【図５】　本発明の更に他の実施例を示すセンサ素子の主要部の断面と回路図である。

【図６】　本発明のさらに別の実施例を示すセンサ素子の主要部の断面と電気回路を示す。

【図７】　従来のセンサ素子の構成例を示す断面と回路図である。

【図８】　従来のセンサ素子の他の構成例を示す断面と回路図である。

【符号の説明】

１…主ポンプ手段（電気化学的ポンプセル）、２…固体電解質隔壁、３，４…電極、５…ガス拡散抵抗層、６，７…出力端子、８，８８…固定抵抗、９…電源、１０，１１…電流検出手段、１３，１４…電極、１６…ヒータ、２０…測定用ポンプ手段、２１…電気化学的ポンプセル、２３，２４…電極、２６，２７…出力端子、２

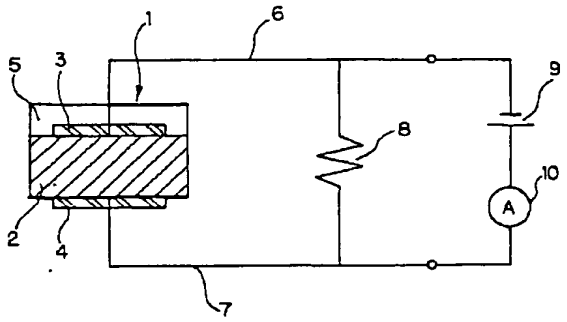
13

８，５６，６８…固定抵抗、２９，６９…コンデンサ、３０，７０…交流電源、３１，７１…コンデンサ、３２，３３…抵抗、３５…電位差検出手段、４０…ヒータ部、４１…第一の拡散律速部、４２…第一の内部空所、４３…第二の拡散律速部、４４…第二の内部空所、４

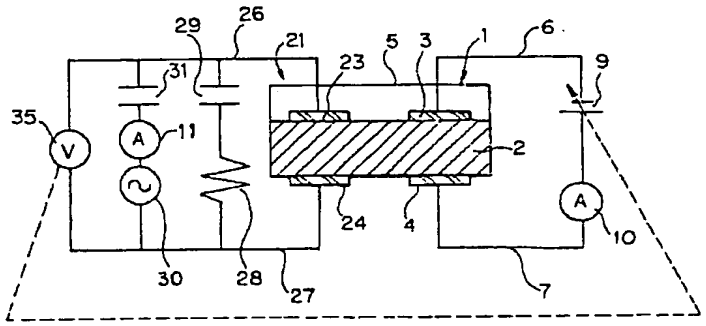
14

５，４６…電極、４７…基準ガス導入空間、４８…ヒータ用電源、５１…拡散律速部、５２…内部空所、５３，５４…電極、５５…電位差検出手段、８０…補助ポンプ電極、９０…濃度検出手段。

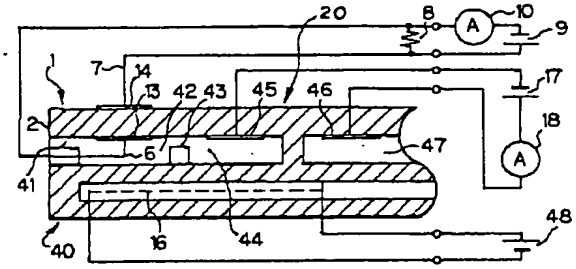
【図１】



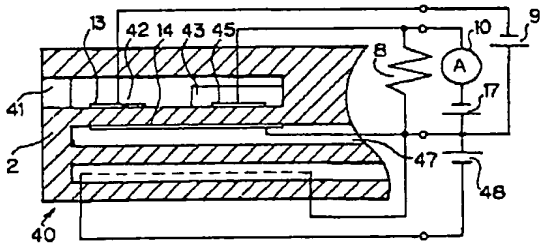
【図２】



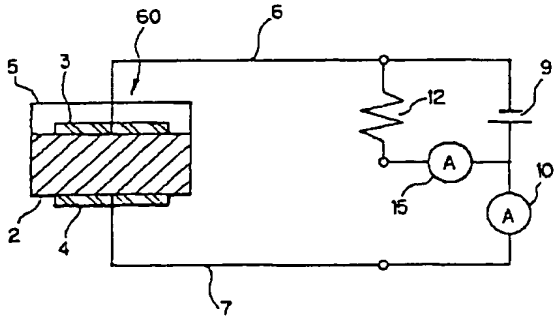
【図３】



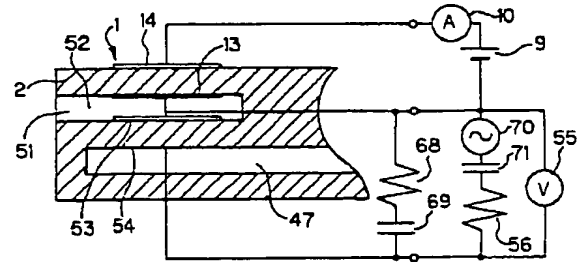
【図４】



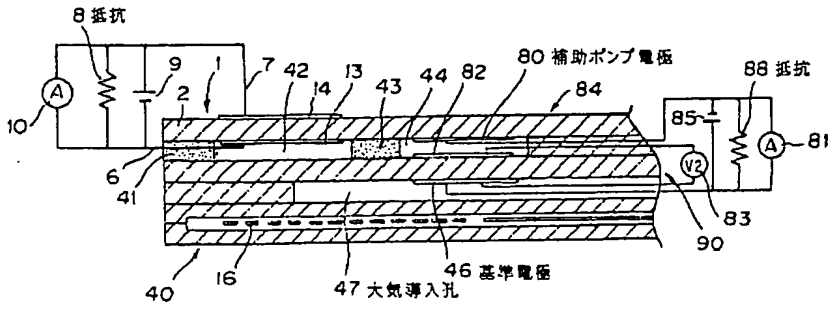
【図７】



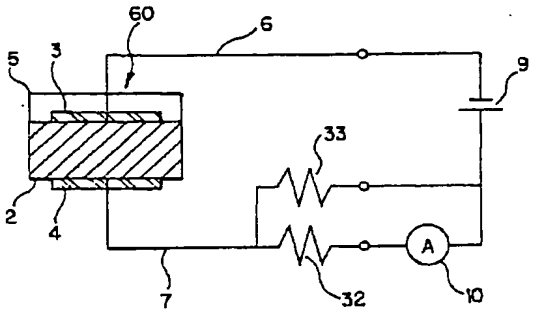
【図５】



【図６】


8 抵抗
9
1
7
42
14
13
43
44
82
80 補助ポンプ電極
84
88 抵抗
85
2
10
A
6
41
V2
83
81
90
40
16
47 大気導入孔
46 基準電極

【図８】


60
6
5
3
9
33
2
4
A
7
32
10

JAPANESE [JP,09-318594,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS EXAMPLE DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] A solid electrolyte septum which touches outer space A main-process-pump means which carries out pumping processing based on control voltage to which oxygen contained in measured gas which has an electrochemical pump cel which consists of an inside pump electrode and an outside pump electrode which were formed in an inner surface and an outside surface of this solid electrolyte septum, and was introduced from said outer space is impressed by said inside pump electrode and said outside pump inter-electrode It is the gas sensor equipped with the above, and is characterized by connecting an RLC element which has electric predetermined weighted solidity corresponding to weighted solidity of said electrochemical pump cel in said electrochemical pump cel at juxtaposition.
[Claim 2] A solid electrolyte septum which touches outer space A main-process-pump means which carries out pumping processing based on control voltage to which oxygen contained in measured gas which has an electrochemical pump cel which consists of an inside pump electrode and an outside pump electrode which were formed in an inner surface and an outside surface of this solid electrolyte septum, and was introduced from said outer space is impressed by said inside pump electrode and said outside pump inter-electrode An electrical signal conversion means generate an electrical signal according to an amount of oxygen generated by decomposition or reduction of the object component included in measured gas after one side has a detection electrode of a couple prepared in a side into which measured gas by which pumping processing was carried out is introduced with said main-process-pump means and pumping processing was carried out with said main-process-pump means It is the gas sensor equipped with the above, and is characterized by connecting an RLC element which has electric predetermined weighted solidity corresponding to the electrical signal property of said gas sensor in juxtaposition at an output terminal of said electrochemical pump cel or said electrical signal conversion means.
[Claim 3] A gas sensor according to claim 2 which is equipped with the following and characterized by measuring the amount of specific components in measured gas based on pump current detected with said current detection means. A pump means for measurement in which said electrical signal conversion means carries out pumping processing based on voltage for measurement to which oxygen generated by decomposition or reduction of the object component included in measured gas after pumping processing was carried out with said main-process-pump means is impressed by the detection inter-electrode of said couple A current detection means to detect pump current produced for said pump means for measurement

[Claim 4] A gas sensor according to claim 2 which is equipped with the following and characterized by measuring the amount of specific components in measured gas based on electromotive force detected with said voltage detection means. An amount of oxygen generated by decomposition or reduction of the object component included in measured gas after pumping processing of said electrical signal conversion means was carried out with said main-process-pump means A concentration detection means to generate electromotive force according to a difference with an amount of oxygen contained in contrast gas by the side of a detection electrode prepared in a contrast gas side A voltage detection means to detect electromotive force produced for said concentration detection means

[Claim 5] A gas sensor according to claim 1 or 2 said whose RLC element is resistance.

[Claim 6] A gas sensor according to claim 1 or 2 which is at least one chosen from a group which said RLC element becomes from a series circuit of a capacitor, a capacitor, and resistance, and a series circuit of a capacitor and an inductor.

[Claim 7] A gas sensor according to claim 1 or 2 in which said RLC element has the maximum or the minimal value in specific frequency.

[Claim 8] A solid electrolyte septum which touches outer space An electrochemical pump cel which consists of an inside pump electrode and an outside pump electrode which were formed in an inner surface and an outside surface of this solid electrolyte septum Are the measuring method of the amount of specific components in measured gas equipped with the above, and in said electrochemical pump cel, while connecting to juxtaposition an RLC element which has electric predetermined weighted solidity corresponding to weighted solidity of said electrochemical pump cel By connecting the ends to a sensor output terminal, and measuring electric weighted solidity of said RLC element in the condition of having eliminated the ion conductivity of a solid electrolyte, in ordinary temperature Setting out which amends an output in the elevated temperature of said electrochemical pump cel is performed, and it is characterized by amending an output of said electrochemical pump cel based on this setting out.

[Claim 9] A solid electrolyte septum which touches outer space An electrochemical pump cel which consists of an inside pump electrode and an outside pump electrode which were formed in an inner surface and an outside surface of this solid electrolyte septum It is the measuring method of the amount of specific components in measured gas equipped with the above, and by measuring electric weighted solidity of said RLC element in the condition of having eliminated the ion conductivity of a solid electrolyte, setting out which amends an output in the elevated temperature of said electrical signal conversion means is performed, and it is characterized by amending an output of said electrical signal conversion means based on this setting out.

[Claim 10] A measuring method according to claim 8 or 9 said whose RLC element is resistance.

[Claim 11] A measuring method according to claim 8 or 9 which is at least one chosen from a group which said RLC element becomes from a series circuit of a capacitor, a capacitor, and resistance, and a series circuit of a capacitor and an inductor.

[Claim 12] A measuring method according to claim 8 or 9 in which said RLC element has the maximum or the minimal value in specific frequency.

[Translation done.]

JAPANESE [JP,09-318594,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS EXAMPLE DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention relates to the gas sensor and measuring method which can amend dispersion in the output characteristics between sensors correctly and easily especially with respect to the measuring method of the amount of specific components in the gas sensor which detects the amount of specific components in measured gas, and measured gas.
[0002]
[Description of the Prior Art] The method of measuring, the specific component of oxygen gas, for example, amount, in measured gas, is learned by measuring the diffusion limiting current at the time of energizing between these two electrodes conventionally using the electrochemical pump cel which prepared the electrode of a couple in the septum which consists of solid electrolytes, such as zirconia ceramics. Under the present circumstances, diffusion limiting current needed to carry out amendment according to the sensitivity of each sensor element, in order to change with variations, such as structure of a sensor element especially a microstructure of an electrode, and porosity of a gaseous diffusion resistive layer, and to perform exact measurement. In carrying out this amendment, unlike the sensor used for an analyzer etc., in the sensor as autoparts, individual variation of a sensor property cannot be adjusted by the interface side. So, a means to amend a certain individual variation was required for the sensor for automobile loading.
[0003] As a method of amending such individual variation, as conventionally shown in 1 drawing 8 , diffusion limiting current was shunted using two resistance 32 and 33, and after measuring the property of the method of adjusting diffusion limiting current to a predetermined value, and two sensors, as shown in a rank part opium poppy and drawing 7 , the method of building the fixed resistance 12 of the value corresponding to each rank for the property in a connector case etc. was.
[0004] The electrodes 3 and 4 of a couple with which the method shown in drawing 8 was formed in the solid electrolyte septum 2, and its inner surface and outside surface, It is the thing in which the circuit which has a power supply 9 and the current detection means 10 was formed between the output terminal 6 of the electrochemical pump cel 60 which consists of a gaseous diffusion resistive layer 5 prepared on this electrode 3, and 7. It is the method of passing the current which shunted the diffusion limiting current which flows in the electrochemical pump cel 60 by resistance 32 and 33, and is proportional to the current detection means 10 at the concentration of the specific component in

measured gas. Moreover, by the method of drawing 7 , to the sensor which comes to form the circuit which has a power supply 9 and the current detection means 10 between the output terminal 6 of the electrochemical pump cel 60 which consists of electrodes 3 and 4 of the couple prepared in the inner surface and outside surface of the solid electrolyte septum 2, and a gaseous diffusion resistive layer 5 prepared on this electrode 3, and 7, after measuring the property, the rank division of the property is carried out. Subsequently, as shown in drawing 7 , it is the way another current detection means 15 which combined with the electrochemical pump cel 60 the connector case which contained the fixed resistance 12 of the value corresponding to each rank, and connected with this fixed resistance 12 at the serial detects current.

[0005]

[Problem(s) to be Solved by the Invention] However, in the sensor which prepared the above-mentioned diversion-of-river resistance, or the sensor which attached the fixed resistance of the value corresponding to each rank, the number of terminals of a connector increased, lowering of reliability and lifting of cost were imitated and there was a defect of **. This invention aims at offering the amendment method which can solve the technical problem of the amendment method of these former.

[0006]

[Means for Solving the Problem] A solid electrolyte septum which touches outer space according to this invention in order to attain the above-mentioned object, It has an electrochemical pump cel which consists of an inside pump electrode and an outside pump electrode which were formed in an inner surface and an outside surface of this solid electrolyte septum. And come to have a main-process-pump means which carries out pumping processing based on control voltage to which oxygen contained in introduced measured gas is impressed by said inside pump electrode and said outside pump inter-electrode from said outer space. It is the gas sensor which detects the amount of specific components in measured gas, and said electrochemical pump cel is provided with a gas sensor characterized by connecting an RLC element which has electric predetermined weighted solidity corresponding to weighted solidity of said electrochemical pump cel in juxtaposition.

[0007] Moreover, according to this invention, it has an electrochemical pump cel which consists of an inside pump electrode and an outside pump electrode which were formed in an inner surface and an outside surface of a solid electrolyte septum which touches outer space, and this solid electrolyte septum. And a main-process-pump means which carries out pumping processing based on control voltage to which oxygen contained in introduced measured gas is impressed by said inside pump electrode and said outside pump inter-electrode from said outer space, It has a detection electrode of a couple prepared in a side into which measured gas by which pumping processing of one side was carried out with said main-process-pump means is introduced. An electrical signal conversion means to generate an electrical signal according to an amount of oxygen generated by decomposition or reduction of the object component included in measured gas after pumping processing was carried out with said main-process-pump means, It is the gas sensor which detects the amount of specific components in preparation **** measurement gas. An output terminal of said electrochemical pump cel or said electrical signal conversion means is provided with a gas sensor characterized by connecting an RLC element which has electric predetermined weighted solidity corresponding to the electrical signal property of said gas sensor in juxtaposition. In this invention, an electrical signal

conversion means oxygen generated by decomposition or reduction of the object component included in measured gas after pumping processing was carried out with a main-process-pump means A pump means for measurement which carries out pumping processing based on voltage for measurement impressed to the detection inter-electrode of a couple, A thing possessing a current detection means to detect pump current produced for this pump means for measurement is desirable, and measures the amount of specific components in measured gas in this case based on pump current detected with a current detection means. Moreover, an amount of oxygen generated by decomposition or reduction of the object component included in measured gas after pumping processing of this electrical signal conversion means was carried out with a main-process-pump means, A concentration detection means to generate electromotive force according to a difference with an amount of oxygen contained in contrast gas by the side of a detection electrode prepared in a contrast gas side, A voltage detection means to detect electromotive force produced for this concentration detection means may be provided, and the amount of specific components in measured gas is measured in this case based on electromotive force detected with a voltage detection means.
[0008] Furthermore, according to this invention, a main-process-pump means of a sensor to have an electrochemical pump cel which consists of an inside pump electrode and an outside pump electrode which were formed in an inner surface and an outside surface of a solid electrolyte septum which touches outer space, and this solid electrolyte septum is used. By carrying out pumping processing based on control voltage to which oxygen contained in introduced measured gas is impressed by said inside pump electrode and said outside pump inter-electrode from said outer space, and controlling oxygen tension in measured gas to a predetermined value In a method of measuring the amount of specific components in measured gas, in said electrochemical pump cel, while connecting to juxtaposition an RLC element which has electric predetermined weighted solidity corresponding to weighted solidity of said electrochemical pump cel By connecting the ends to a sensor output terminal, and measuring electric weighted solidity of said RLC element in the condition of having eliminated the ion conductivity of a solid electrolyte, in ordinary temperature Setting out which amends an output in the elevated temperature of said electrochemical pump cel is performed, and a measuring method of the amount of specific components in measured gas characterized by amending an output of said electrochemical pump cel based on this setting out is offered.
[0009] A solid electrolyte septum which touches outer space further again according to this invention, A main-process-pump means of a sensor to have an electrochemical pump cel which consists of an inside pump electrode and an outside pump electrode which were formed in an inner surface and an outside surface of this solid electrolyte septum is used. By carrying out pumping processing based on control voltage to which oxygen contained in introduced measured gas is impressed by said inside pump electrode and said outside pump inter-electrode from said outer space Control oxygen tension in measured gas to a predetermined value, and an electrical signal conversion means to have a detection electrode of a couple prepared in a side into which measured gas by which pumping processing of one side was carried out with said main-process-pump means is introduced is used. The object component contained in measured gas after pumping processing was carried out with said main-process-pump means It changes into an electrical signal according to an amount of oxygen generated by decomposition or reduction. Based on an electrical signal from said electrical signal conversion means, measure the amount of specific components in measured gas. While connecting

an RLC element which is the measuring method of the amount of specific components in measured gas, and has electric predetermined weighted solidity corresponding to the property of said electrical signal at juxtaposition in an output terminal of said electrochemical pump cel or said electrical signal conversion means By connecting the ends to a sensor output terminal, and measuring electric weighted solidity of said RLC element in the condition of having eliminated the ion conductivity of a solid electrolyte, in ordinary temperature Setting out which amends an output in the elevated temperature of said electrical signal conversion means is performed, and a measuring method of the amount of specific components in measured gas characterized by amending an output of said electrical signal conversion means based on this setting out is offered.

[0010] Before an interface carried in an automobile by this invention about amelioration of a conventional method 2 which described this invention above as above has memorized correction value according to each rank and operates a sensor, it will read a label by the side of a sensor, will choose predetermined correction value, and will amend a sensor output. In addition, in this invention, it is desirable that an RLC element is resistance (R), and it is desirable that an RLC element is a series circuit of a capacitor (C), a capacitor (C), and resistance (R) or the series circuit of a capacitor (C) and an inductor (L). Furthermore, vibrator, a filter, etc. with which an impedance etc. has the maximal value or the minimal value in specific frequency besides combination of these resistance, a capacitor, and an inductor as an RLC element can also be used.

[0011]

[Embodiment of the Invention] The solid electrolyte septum 2 in which drawing 1 is the circuit diagram showing an example of the fundamental configuration of this invention, and ion conductivity is not substantially shown in ordinary temperature, such as zirconia ceramics, but ion conductivity is shown in an elevated temperature, The fixed resistance 8 which has the resistance corresponding to the sensitivity of this cel in the output terminals 6 and 7 of the electrochemical pump cel 1 which consists of electrodes 3 and 4 of the couple prepared in the inner surface and outside surface and a gaseous diffusion resistive layer 5 prepared on this electrode 3 is connected to juxtaposition.

[0012] If predetermined voltage (control voltage) is impressed to the output terminals 6 and 7 of the electrochemical pump cel 1 from a power supply 9 when a sensor circuit is constituted as mentioned above, in ordinary temperature, since the impedance of said cel 1 is dramatically high, in a cel 1, current will hardly flow, but current will flow only mainly to fixed resistance 8. Therefore, if this current is measured with the current detection means 10, the resistance of fixed resistance 8 can be read. Since this resistance is set as the value corresponding to the sensitivity of each cel, it makes the current detection means 10 which flows in a cel able to memorize that information, and can amend a current value when a cel carries out operating at high temperatures based on a degree type.

[0013] I0 =Kn (In -V/Rn)

However, I0 The diffusion-limiting-current value after the correction by sensitiveness of a cel, and Kn The correction factor corresponding to the sensitivity of each cel, and In The current value and Rn which flow for the current detection means 10 The resistance of fixed resistance 8 and V are the voltage of a power supply 9. In addition, let internal resistance of the current detection means 10 be a thing small to the degree which can be disregarded.

[0014] Here, as weighted solidity (when it has an electrical signal conversion means like drawing 3 mentioned later - drawing 5 , it is the electrical signal property of a sensor) of the electrochemical

pump cel which the electric weighted solidity of the RLC element which is resistance represents in drawing 1 , the sensitivity of a cel (sensor output) and an offset value are mentioned. As sensitivity of a cel (sensor output), there is a rate of change at resistance of comparatively as opposed to the concentration of the specific component in gas measured [**] at the reduction of electromotive force to comparatively as opposed to the concentration of the specific component in gas measured [**] at the increment in the pump current over the concentration of the specific component in gas measured [**] etc. Moreover, there is resistance generated when the concentration of the value of the pump current which flows as an offset value of a cel (sensor output) when the concentration of the specific component in gas measured [**] is 0, and the specific component in gas measured [**] is 0 in case the concentration of the value of electromotive force and the specific component in gas measured [**] is 0.

[0015] Consequently, it sets to drawing 1 and is I0. It becomes the value which amended the variation in the sensitivity of each cel, and the presentation of measured gas and very good correlation will be acquired. In addition, fixed resistance 8 is burned as cermet resistance on a sensor element, and may be held in the connector case of a sensor.

[0016] Drawing 2 is the circuit diagram showing an example of other basic configurations of this invention, and forms the circuit which has a power supply 9 and the current detection means 10 between the output terminal 6 of the electrochemical pump cel 1 which consists of a gaseous diffusion resistive layer 5 prepared like the basic configuration of drawing 1 on the solid electrolyte septum 2, the electrodes 3 and 4 of the couple prepared in the inner surface and outside surface, and this electrode 3, and 7. Moreover, the electrochemical pump cel 21 was constituted from a gaseous diffusion layer 5 which formed the electrodes 23 and 24 of a couple in the inner surface and outside surfaces of the solid electrolyte septum 2, such as zirconia ceramics, further, and was prepared on this electrode 23, and the fixed resistance 28 with the resistance corresponding to the sensitivity of the electrochemical pump cel 1 which adjoins this cel 21 at the output terminals 26 and 27 is connected to juxtaposition through a capacitor 29.

[0017] If predetermined voltage is impressed to the output terminals 26 and 27 of a cel 21 through a capacitor 31 from AC power supply 30 when a sensor circuit is constituted as mentioned above, in ordinary temperature, since the impedance of a cel 21 is dramatically high, in a cel 21, current will hardly flow, but current will flow only mainly to fixed resistance 28. Therefore, if this current is measured with the second current detection means 11, the resistance of fixed resistance 28 can be read. Since this resistance is set as the value corresponding to the sensitivity of the electrochemical pump cel 1, it makes the second current detection means 11 able to memorize that information, and can amend a current value when a cel 21 carries out operating at high temperatures based on a degree type.

[0018] I0 =Kn xIn, however I0 The diffusion-limiting-current value after the correction by sensitiveness of a cel, and Kn The correction factor corresponding to the sensitivity of each cel, and In It is the current value which flows for the current detection means 10.

[0019] According to this method, even if the electrochemical pump cel 21 is a cel of the method which measures electromotive force, without affecting the current detector of the electrochemical pump cel 1, it becomes possible to amend without affecting that electromotive force. For example, in drawing 2 , with the potential difference (voltage) detection means 35, the electromotive force according to an

electrode 23 and the oxygen density difference between 24 will be measured, and the voltage impressed to the electrochemical pump cel 1 so that this electromotive force may be controlled to a predetermined value is adjusted.

[0020]

[Example] Hereafter, the example of this invention is further explained to details, referring to a drawing. Drawing 3 shows the cross section and electrical circuit of the body equipped with the heater section of a NOx sensor. In drawing 3 , in the NOx sensor, as the first internal dead air space 42 is located, while the first internal dead air space 42 and the second internal dead air space 44 are separately arranged in the sensor element head side, in the gestalt which became independent in the internal dead air space 42 of them first, and the second internal dead air space 44, it is prepared so that the reference gas installation space 47 as reference gas existence dead air space may extend in the longitudinal direction of a sensor element. Moreover, while the first diffusion limitation section 41 which makes external measured gas existence space open the first internal dead air space 42 for free passage is formed at the head of a sensor element, the first internal dead air space 42 and the second internal dead air space 44 are open for free passage through the second diffusion limitation section 43.

[0021] The inside pump electrode 13 is formed, the outside pump electrode 14 is formed in the outside part of the solid electrolyte septum 2 corresponding to this inside pump electrode 13, and the main-process-pump means (electrochemical pump cel) 1 is constituted by these electrodes 13 and 14 and the solid electrolyte septum 2 by the portion exposed in the first [of the solid electrolyte septum 2] internal dead air space 42. And while forming the circuit which has a power supply 9 and the current detection means 10 between the output terminal 6 of the main-process-pump means 1, and 7, the fixed resistance 8 which has the resistance corresponding to the sensitivity of this main-process-pump means 1 between an output terminal 6 and 7 is connected to juxtaposition.

[0022] Furthermore, while the measuring electrode 45 is formed, the reference electrode 46 is formed in the portion exposed in the reference gas installation space 47 of the solid electrolyte septum 2, and the pump means 20 for measurement is constituted by the portion exposed in the second [of the solid electrolyte septum 2] internal dead air space 44 by these measuring electrodes 45, the reference electrode 46, and the solid electrolyte septum 2. And between the output terminals of the pump means 20 for measurement, the circuit which has a power supply 17 and the current detection means 18 is formed. In addition, the heater section 40 is formed in the NOx sensor, a heater 16 is laid underground with the gestalt surrounded with the solid electrolyte, and it is made to generate heat by the feed from the power supply 48 for heaters.

[0023] In the NOx sensor of such a configuration, the value of the diffusion limiting current of oxygen gas is calculated by the current detection means 10 by measured gas's going into the first internal dead air space 42 through the first diffusion limitation section 41, and energizing from the power supply 9 which has predetermined voltage in the pump electrodes 13 and 14 of the couple countered and prepared in the inside-and-outside side of the solid electrolyte septum 2 which consists of zirconia ceramics here. Moreover, NOx is also measured by NO which is not decomposed with this internal dead air space 42 going into the second internal dead air space 44 through the second diffusion limitation section 43, and NO's being decomposed by the voltage impressed between a measuring electrode 45 and a reference electrode 46 according to a power supply 17 here, and

asking for the oxygen emitted in connection with it with the current detection means 18. If the value of resistance 8 is set as the value corresponding to the sensitivity to the oxygen gas in the first internal dead air space 42, or the sensitivity to the NOx gas in the second internal dead air space 44 here, in ordinary temperature, the value of resistance 8 can be measured with the current detection means 10, and the correction factor based on the value can amend the pump current value which flows for the main-process-pump means 1, or the current value which flows for the pump means 3 for measurement. Since the main-process-pump means 1 does not decompose NO in amending NOx concentration especially, since the current which flows to resistance 8 is unrelated to NOx measurement, amendment of NOx sensitivity or offset can perform it with a sufficient precision.

[0024] Drawing 4 shows the cross section and electrical circuit of the body of another NOx sensor. In this example, into a NOx sensor, only the first internal dead air space 42 is formed, and the second internal dead air space 44 is not arranged, but the second diffusion limitation section 43 which consists of a gaseous diffusion resistive layer is formed instead of the second internal dead air space 44, and what has the catalytic activity which moreover decomposes NOx gas as a measuring electrode 45 is used. And the inside pump electrode 13 is formed, on the other hand, in the portion exposed in the first [of the solid electrolyte septum 2] internal dead air space 42, the outside pump electrode 14 which shares a reference electrode is formed, and the main-process-pump means 1 is constituted by these electrodes 13 and 14 and the solid electrolyte septum 2 by the portion exposed in the reference gas installation space 47 of the solid electrolyte septum 2 at it. And the circuit which has a power supply 9 is formed between the output terminals of the main-process-pump means 1. moreover, into another portion exposed in the first internal dead air space 42 While the second diffusion limitation section 43 which the measuring electrode 45 which has the catalytic activity which decomposes NOx gas is formed, covers this measuring electrode 45, and consists of a gaseous diffusion resistive layer is formed The reference electrode 14 shared with an outside pump electrode is formed in the portion exposed in the reference gas installation space 47 of the solid electrolyte septum 2, and the pump means for measurement is constituted by these measuring electrodes 45, the reference electrode 14, and the solid electrolyte septum 2. And while the circuit which has a power supply 17 and the current detection means 10 is formed between the output terminals of the pump means for measurement, fixed resistance 8 is connected to juxtaposition between the output terminals of this electrochemical sensor cel.

[0025] By such NOx sensor of a configuration, measured gas makes a zero state mostly the oxygen in the first internal dead air space 42 by going into the first internal dead air space 42 through the first diffusion limitation section 41, and energizing from the power supply 9 which has predetermined voltage in the electrodes 13 and 14 of the couple countered and prepared in the inside-and-outside side of the solid electrolyte septum 2 which consists of zirconia ceramics here. Next, it decomposes here and the NOx gas which reached the measuring electrode 45 which has catalytic activity through the second diffusion limitation section 43 emits oxygen. NOx is measured by asking for this oxygen with the current detection means 10. If the value of resistance 8 is set as the value corresponding to the sensitivity to NOx gas here, in ordinary temperature, the value of resistance 8 can be measured with the current detection means 10, and the correction factor based on the value can amend NOx sensitivity with a sufficient precision.

[0026] Drawing 5 shows the cross section and electrical circuit of the body of a diffusion-limiting-

current mold oxygen sensor. In this example, the inside pump electrode 13 is formed, the outside pump electrode 14 is formed in the outside part of the solid electrolyte septum 2 corresponding to this inside pump electrode 13, and the main-process-pump means 1 is constituted by these electrodes 13 and 14 and the solid electrolyte septum 2 by the portion exposed in the internal dead air space 52 of the solid electrolyte septum 2. On the other hand, while the measuring electrode 53 is formed, the reference electrode 54 is formed in the portion exposed in the reference gas installation space 47 of the solid electrolyte septum 2, and the oxygen concentration cell is constituted by other disclosure portions in the internal dead air space 52 of the solid electrolyte septum 2 by these measuring electrodes 53, the reference electrode 54, and the solid electrolyte septum 2. And while forming the circuit which has a power supply 9 and the current detection means 10 between the output terminals of the main-process-pump means 1, the series circuit of a capacitor 71 was connected with AC power supply 70 and resistance 56 between the output terminals of an oxygen concentration cell, and the series circuit of resistance 68 and a capacitor 69 is connected to juxtaposition between the output terminals of this oxygen concentration cell.

[0027] In the oxygen sensor of such a configuration, measured gas makes a zero state mostly the oxygen in the internal dead air space 52 by going into the internal dead air space 52 through the diffusion limitation section 51, and energizing from the power supply 9 which has predetermined voltage in the electrodes 13 and 14 of the couple countered and prepared in the inside-and-outside side of the solid electrolyte septum 2 which consists of zirconia ceramics here. The oxygen tension in the internal dead air space 52 is detected with the potential difference detection means 55 by the oxygen concentration cell which consists of electrodes 53 and 54 and a solid electrolyte 2 as electromotive force which becomes settled by the ratio with the oxygen tension in the reference gas installation space 47, and the voltage of a power supply 9 is controlled to become equal to a predetermined value. At this time, the current which flows for the current detection means 10 corresponds to the oxygen density in measured gas. Here, if the value of resistance 68 is set as the value corresponding to the sensitivity to oxygen gas, in ordinary temperature, the value of resistance 68 can be measured with the potential difference (voltage) detection means 55 as a value which pressured partially the voltage of AC power supply 70 by resistance 56 and resistance 68, and the sensitivity can be doubled with the sensitivity of each sensor. However, let the impedance of capacitors 69 and 71 be a sufficiently small thing.

[0028] Drawing 6 is equipped with the auxiliary-pump cel for adjusting further change of O2 very small partial pressure of the measured gas by whichOmain-process-pump cel 2 partial pressure was adjusted by one, and shows the cross section and electrical circuit of the body of a sensor element which measure NOx concentration with electromotive force. The point which is fundamentally the same as compared with the example of drawing 3 as for the configuration of the main-process-pump means 1 and the heater section 40, and is different in this example is in the place detected from having formed the auxiliary-pump electrode 80 and the electromotive force which generates NOx concentration for the concentration detection means 90 which consists of a detection electrode 82 and a reference electrode 46.

[0029] In this example, while forming the output terminal 6 of the main-process-pump means 1, and the circuit which has a power supply 9 among seven, the fixed resistance 8 which has the resistance corresponding to the sensitivity of this concentration detection means 90 between an output terminal

6 and 7 is connected to juxtaposition.

[0030] While the detection electrode 82 is formed, the reference electrode 46 is formed in the portion exposed in the reference gas installation space 47 of the solid electrolyte septum 2, and the concentration detection means 90 is constituted by the portion exposed in the second [of the solid electrolyte septum 2] internal dead air space 44 by these detection electrode 82, the reference electrode 46, and the solid electrolyte septum 2. Moreover, the auxiliary-pump electrode 80 is formed in another portion in the second internal dead air space 44, and the auxiliary-pump means 84 is constituted by this auxiliary-pump electrode 80, the reference electrode 46 prepared in the reference gas installation space 47, and the solid electrolyte septum 2. And the potential difference detection means 83 was established between the output terminals of this concentration detection means 90, and while, forming the circuit which has a power supply 85 between the output terminals of the auxiliary-pump means 84 on the other hand, the fixed resistance 88 which has the resistance corresponding to the offset value of this concentration detection means 90 between output terminals is connected to juxtaposition.

[0031] In the NOx sensor of such a configuration, measured gas goes into the first internal dead air space 42 through the first diffusion limitation section 41, and oxygen tension is controlled by the oxygen pumping operation which takes place by energizing predetermined voltage from a power supply 9 to the pump electrodes 13 and 14 of the couple countered and prepared in the inside-and-outside side of the solid electrolyte septum 2 here by the predetermined value which NO does not decompose. The measured gas by which oxygen tension was controlled by the predetermined value goes into the second internal dead air space 44 through the second diffusion limitation section 43, and is adjusted to still lower oxygen tension by the voltage impressed between the auxiliary-pump electrode 80 and a reference electrode 46 according to a power supply 85. NO similarly arranged in the second internal dead air space 44 here -- resolution -- NO is decomposed on the powerful detection electrode 82, and NOx concentration is measured by asking for the oxygen generated in connection with it with the potential difference detection means 83.

[0032] Then, if the value of resistance 8 is set as the value corresponding to the offset value of the concentration detection means 90 for the sensitivity (reduction of electromotive force to NOx concentration comparatively) of the concentration detection means 90, and the value of resistance 88, respectively In ordinary temperature, since the optimal correction factor of the sensor can be set up before sensor actuation by measuring the value of resistance 8, and the value of resistance 88 with the current detection means 10 and 81, NOx concentration can be measured with a more sufficient precision. In addition, although the above-mentioned explanation showed the example which allotted two resistance to the element with two electrochemical pump cels, resistance may be other RLC elements. Moreover, according to the number of pump cels, the number of RLC elements can be changed free.

[0033]

[Effect of the Invention] According to this invention, as explained above, the correction by sensitiveness of the sensor of each [the small number of terminals] is possible, and moreover, reliability improves, lifting of cost is not invited and it is very useful on industry.

[Translation done.]

JAPANESE [JP,09-318594,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS EXAMPLE DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the cross section and circuit diagram of the body of a sensor element showing an example of the basic configuration of this invention.
[Drawing 2] It is the cross section and circuit diagram of the body of a sensor element showing other examples of the basic configuration of this invention.
[Drawing 3] It is the cross section and circuit diagram of the body of a sensor element showing one example of this invention.
[Drawing 4] It is the cross section and circuit diagram of the body of a sensor element showing other examples of this invention.
[Drawing 5] It is the cross section and circuit diagram of the body of a sensor element showing the example of further others of this invention.
[Drawing 6] The cross section and electrical circuit of the body of a sensor element which show still more nearly another example of this invention are shown.
[Drawing 7] It is the cross section and circuit diagram showing the example of a configuration of the conventional sensor element.
[Drawing 8] It is the cross section and circuit diagram showing other examples of a configuration of the conventional sensor element.
[Description of Notations]
1 -- A main-process-pump means (electrochemical pump cel), 2 -- Solid electrolyte septum, 3 4 [-- Fixed resistance,] -- An electrode, 5 -- 6 A gaseous diffusion resistive layer, 7 -- 8 An output terminal, 88 9 [-- Heater,] -- 10 A power supply, 11 -- 13 A current detection means, 14 -- An electrode, 16 20 -- The pump means for measurement, 21 -- 23 An electrochemical pump cel, 24 -- Electrode, 26 27 -- An output terminal, 28, 56, 68 -- 29 Fixed resistance, 69 -- Capacitor, 30 70 -- 31 AC power supply, 71 -- 32 A capacitor, 33 -- Resistance, 35 -- A potential difference detection means, 40 -- The heater section, 41 -- The first diffusion limitation section, 42 -- The first internal dead air space, 43 -- The second diffusion limitation section, 44 -- Second internal dead air space, 45 46 [-- The diffusion limitation section, 52 / -- 53 Internal dead air space, 54 / -- An electrode, 55 / -- A potential difference detection means, 80 / -- An auxiliary-pump electrode, 90 / -- Concentration detection means.] -- An electrode, 47 -- Reference gas installation space, 48 -- The power supply for heaters, 51

[Translation done.]